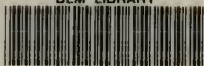


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A GEOSTATISTICAL STUDY FOR
GEOLOGY - ENERGY - MINERAL RESOURCES
IN THE CALIFORNIA DESERT

B R I E F I N G

HD
243
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TERRADATA

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243
124
4.5

BRIEFING

no date

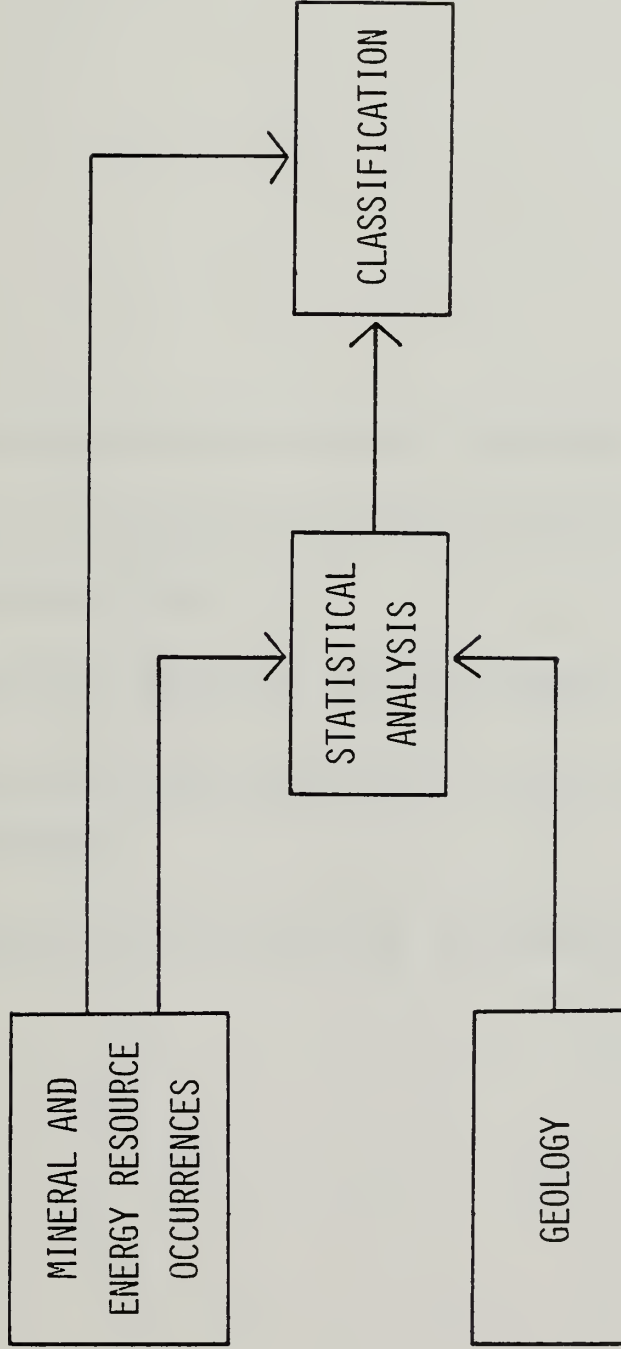
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B R I E F I N G O U T L I N E

- I. INTRODUCTION
- II. RESULTS
- III. COMPILATION OF OCCURRENCE DATA
- IV. COMPILATION OF GEOLOGIC INFORMATION
- V. GEOSTATISTICAL ANALYSIS
- VI. RECOMMENDATIONS

TERRADATA'S APPROACH

1. COMPILE REPORTED MINERAL AND ENERGY OCCURRENCES
2. DIGITIZE GEOLOGY
3. FIND STATISTICAL RELATIONSHIPS BETWEEN
OCCURRENCES AND GEOLOGY
4. CLASSIFY ENERGY AND MINERAL RESOURCE POTENTIAL
OF THE CDCA





II. RESULTS

- A. LOCATION OF REPORTED MINERAL OCCURRENCES
- B. LOCATION OF WELLS DRILLED FOR OIL AND GAS, CO₂ OR GEOTHERMAL FLUIDS
- C. REPORTED AND PREDICTED GOLD OCCURRENCES
- D. REPORTED AND PREDICTED LEAD, SILVER, ZINC OR COPPER OCCURRENCES
- E. REPORTED AND PREDICTED IRON OR MANGANESE OCCURRENCES



MINERAL OCCURRENCES IN THE CDCA^a
BY COMMODITY AND PRODUCTION CATEGORY

Commodity	Symbol	Production Category ^b					Total All Categories
		0	1	2	3	4	
<u>Metals</u>							
Antimony	A	3	5	8	0	0	16
Copper	Cu	86	146	80	12	0	324
Gold	Au	166	400	172	46	22	806
Iron	Fe	29	27	19	1	0	75
Lead	Pb	69	87	46	16	5	223
Manganese	Mn	26	49	21	3	3	102
Mercury	Hg	5	3	1	0	0	9
Nickel	Ni	1	2	0	0	0	3
Molybdenum	Mo	1	1	1	0	0	3
Rare earths	RE	5	7	0	0	1	13
Silver	Ag	5	47	22	2	4	80
Tin	Sn	1	1	0	0	0	2
Titanium	Ti	0	1	0	0	0	1
Thorium	Th	0	1	0	0	0	1
Tungsten	W	30	70	45	3	3	151
Uranium	U	115	15	14	0	0	144
Vanadium	Va	0	1	0	0	0	1
<u>Non-Metals</u>							
Asbestos	As	3	0	1	0	0	4
Barium	Ba	10	7	6	0	0	23
Clay	Cl	13	28	25	5	2	73
Dimension stone	Ds	7	9	18	0	0	34
Feldspar	Fd	8	4	4	0	0	16
Fluorspar	Fl	6	9	3	0	0	18
Gemstones	Gs	22	13	3	0	0	38
Limestone	Ls	48	20	23	2	3	96
Magnesite	Mg	1	9	4	0	0	14
Mica	Mi	3	3	6	0	0	12
Roofing granules	RG	0	1	9	0	0	10
Sand and gravel	SG	39	20	43	12	0	114
Silica	Si	10	1	10	1	1	23
Sulfur	S	1	2	2	0	0	5
Talc	Tc	24	20	11	12	7	74
Volcanic cinders	VC	29	18	18	0	0	65
Wollastonite	Ws	1	1	1	0	0	3
Miscellaneous	Ms	2	2	2	0	0	6
<u>Salines</u>							
Borates	B	35	2	15	2	2	56
Calcium chloride	CC	1	1	3	0	0	5
Gypsum	G	19	7	11	0	1	38
Magnesium salts	MC	1	0	0	0	0	1
Potassium salts	KS	1	1	5	0	0	7
Salt	NC	5	3	10	0	0	18
Sodium carbonate	SC	0	0	4	0	0	4
Sodium sulfate	SS	5	0	2	0	0	7
Strontium	Sr	3	0	4	0	0	7
Total All Commodities		838	1,044	672	117	54	2,725
<u>Wells</u>							
Oil and gas (all are dry holes)							188
Carbon dioxide							8
Geothermal							88
Total Wells							284

^a Data on hot springs (HS) is included in the data base but has not been tabulated.

^b

- 0 = Occurrence or claim
- 1 = Worked, but no production reported
- 2 = Small Producer (less than \$50,000)
- 3 = Moderate Producer (\$50,000 to \$500,000)
- 4 = Major Producer (over \$500,000)

DATA COLLECTION AND PREPARATION

III. COMPILATION OF OCCURRENCE DATA

A. LITERATURE SEARCH

1. PERSONAL CONTACTS
2. IDENTIFY AND COLLECT ALL KNOWN SOURCES
3. ESTABLISH ORIGINAL SOURCES

B. ENCODE DATA

1. SELECT PARAMETERS TO BE ENTERED
2. PLOT OCCURRENCES ON TOPOGRAPHIC MAPS

C. EDIT DATA

IV. COMPILATION OF GEOLOGIC INFORMATION

A. SELECT SOURCES

1. GEOLOGIC MAPS (CDMG 1:250,000)
2. BOUGUER GRAVITY DATA

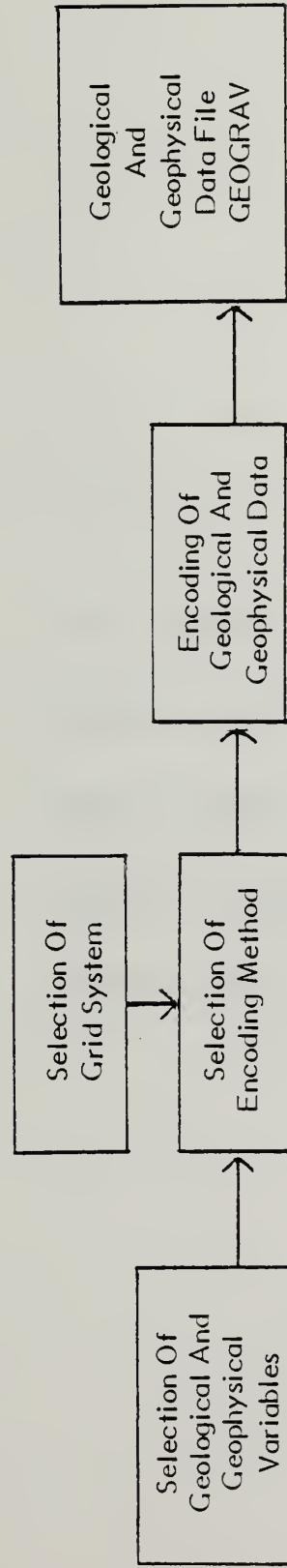
B. SELECT RELEVANT VARIABLES AND UNIT OF COMPILATION

C. ENCODE DATA

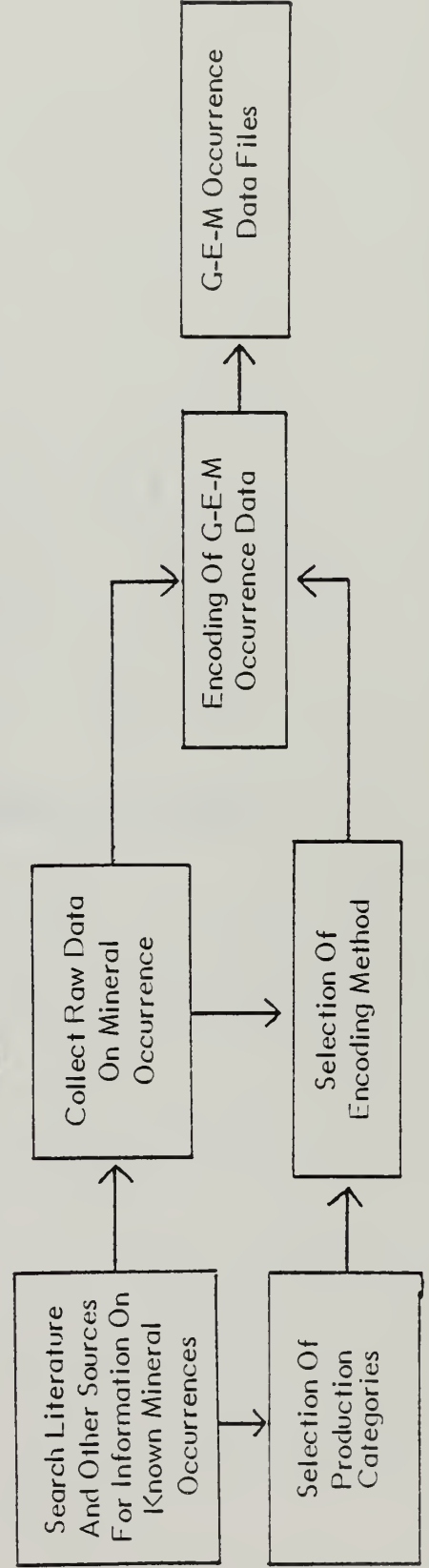
D. EDIT DATA

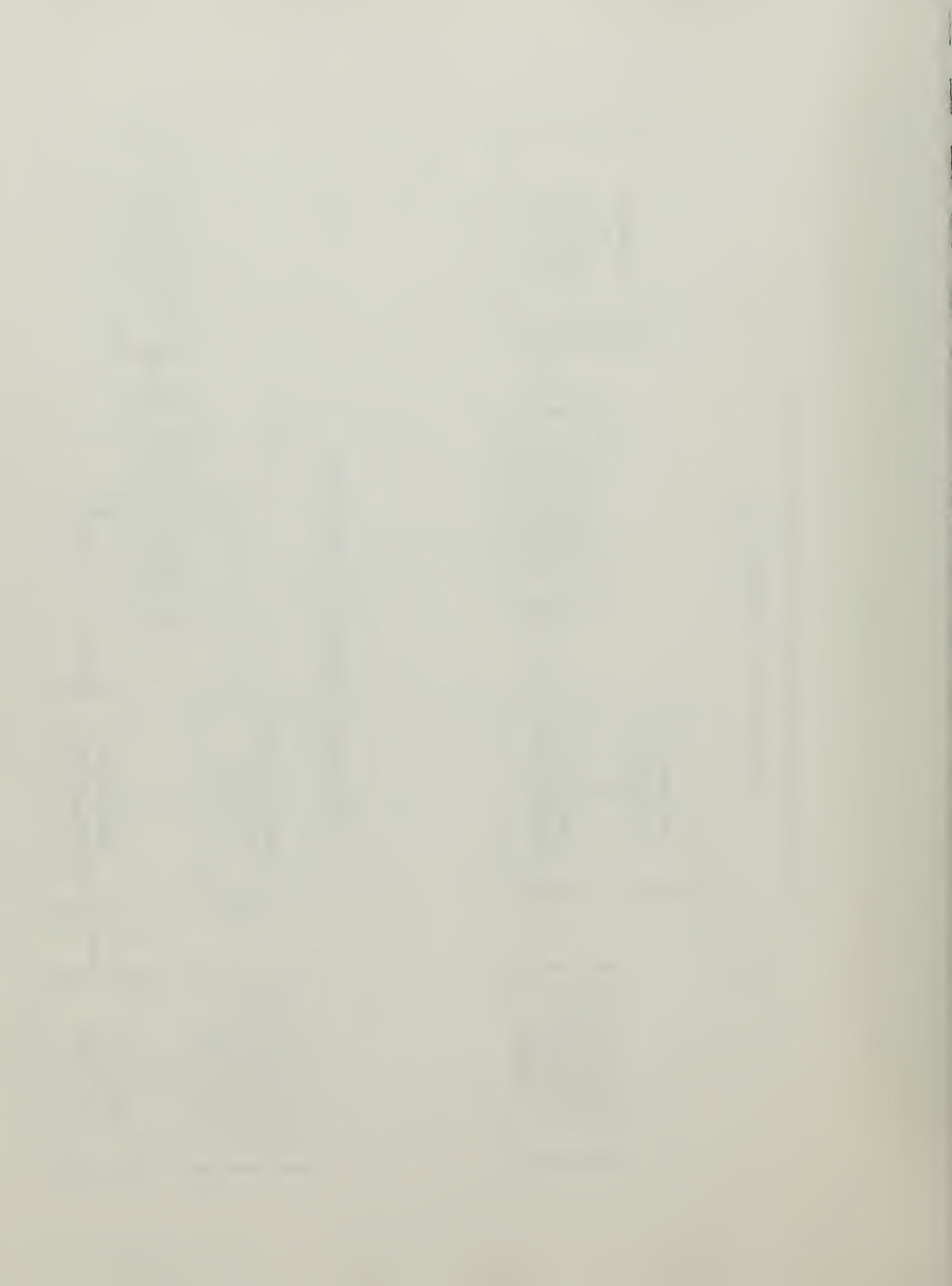
FLOWCHART OF DATA COLLECTION AND PREPARATION

Geological and Geophysical Data



Geology-Energy-Mineral Occurrence Data





DESIRED OCCURRENCE DATA

- o EXACT LOCATION
- o ECONOMIC VALUE OF DEPOSIT
- o COMPLETE PRODUCTION HISTORY (QUANTITY & GRADE)
- o COMMODITY SEPARATION
- o CURRENT STATUS

PERSONS CONTACTED FOR
MINERAL OCCURRENCE INFORMATION

BUREAU OF LAND MANAGEMENT

JEAN JUILLAND

DESERT PLANNING STAFF

BUREAU OF MINES

GARY KINGSTON, WASHINGTON

JIM EVANS, WASHINGTON

JERROLD THOMPSON, DENVER

RICHARD APPLING, SPOKANE

BOB WELDON, SPOKANE

FRED CARRILLO, SPOKANE

BOB MILLER, SPOKANE

BILL KERNS, SACRAMENTO

GEOLOGICAL SURVEY

REID STONE, MENLO PARK

MARSHALL REID, MENLO PARK

BILL LEE, MENLO PARK

ROSCOE SMITH, MENLO PARK

MAUREEN JOHNSON, MENLO PARK

MERRITT SMITH, LOS ANGELES

VIVIAN ENGLER, LOS ANGELES

DEPARTMENT OF ENERGY

SPENCE SHANNON, GRAND JUNCTION

ROBERT MEEHAN, GRAND JUNCTION

FRED FILES, RENO

DAVID LEACH, LAWRENCE LIVERMORE LAB

BUREAU OF RECLAMATION

MR. FUNILIUS, BOULDER CITY, NV

CALIFORNIA DIVISION OF MINES & GEOLOGY

TOM GAY, SACRAMENTO

BILL CLARK, SACRAMENTO

HAL WEBER, UCLA

CLIFF GRAY, LOS ANGELES

ED KIESSLING, LOS ANGELES

PAUL MORTON, SANTA ANA

CALIFORNIA DIVISION OF OIL & GAS

DON LANDE, LOS ANGELES

COUNTY ASSESSORS

DAN BLATT, LOS ANGELES COUNTY

MR. LANTO, SAN BERNARDINO COUNTY

INDIVIDUALS

SHAWN BIEHLER, UC RIVERSIDE

BENNETT TROXEL, UC DAVIS

JIM BRISCOE, SOUTHWESTERN EXPLORA-
TION ASSOCIATES, TUCSON

CHARLES MARDIROSIAN, ALBUQUERQUE

DOROTHY MUNGER, MUNGER OIL INFOR-
MATION, LOS ANGELES

RICHARD DUDA, SRI, MENLO PARK

TERRADATA

IDENTIFY LOCATION OF OCCURRENCES

1. 1:250,000 Topographic Sheets
2. CDMG County Reports
3. DOE Preliminary Reconnaissance
Reports For Uranium
4. Southern Pacific Report:
Minerals For Industry
5. CDMG Economic Mineral Maps
6. USGS Mineral Occurrence Map
7. USGS Planning Unit Reports
8. USBOM Mineral Industry Location
System (MILS)

MAP OF CDCA SHOWING UTM BLOCKS

UTM Blocks of the CDCA
For Reference Only
Exact Locations Should Be
Determined From AMS UTM Map
Sheets

Latitude: 38°, 37°, 36°, 35°, 34°, 33°
Longitude: 118°, 117°, 116°, 115°

UTM Blocks: MM, ML, MK, NK, PK, NJ, PJ, QJ, PH, QH, NG, PG, QG

Cities: Bishop, Bakersfield, Barstow, Los Angeles, Riverside, San Diego

Salton Sea

UTM Blocks of the CDCA
For Reference Only
Exact Locations Should Be
Determined From AMS UTM Map
Sheets

PORTION OF A UTM BLOCK DIVIDED INTO CELLS
UTM BLOCK PG
(Hatched cell is PG0682)

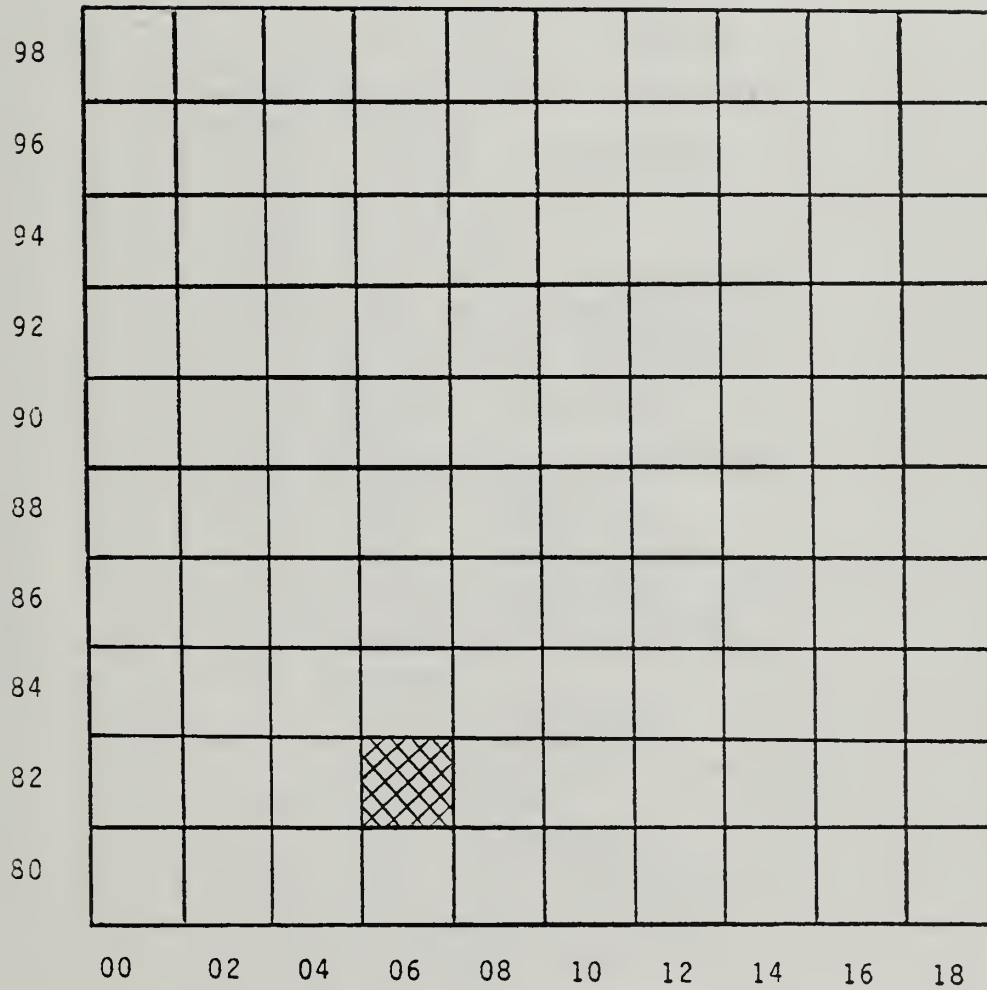


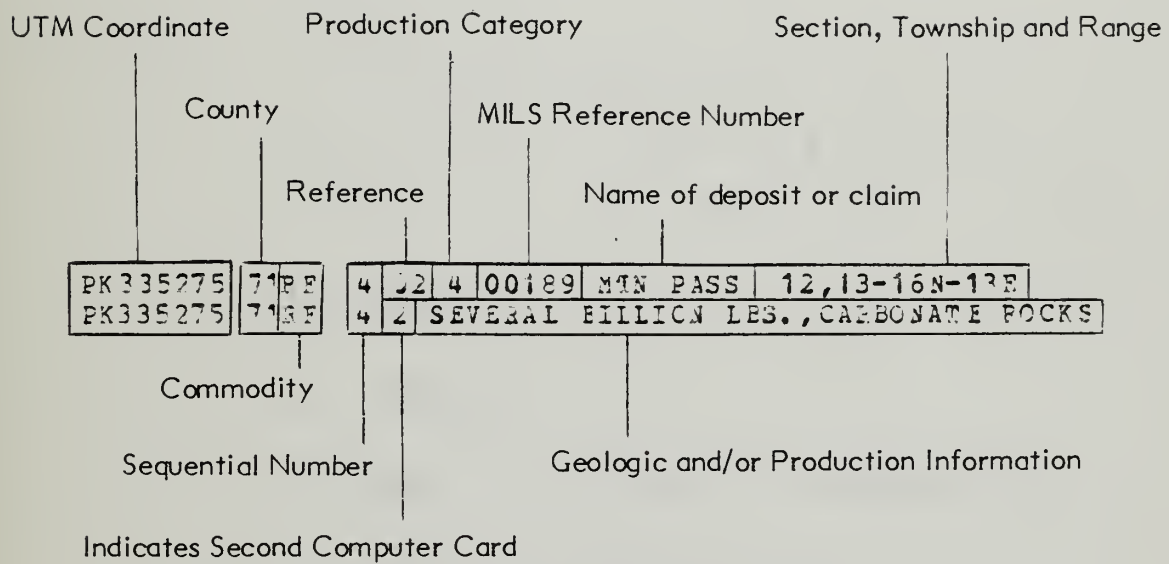
TABLE I			
Summary of the results of the experiments			
Experiment	Time (min)	Distance (m)	Speed (m/min)
1	10	100	10
2	20	200	10
3	30	300	10
4	40	400	10
5	50	500	10
6	60	600	10
7	70	700	10
8	80	800	10
9	90	900	10
10	100	1000	10
11	110	1100	10
12	120	1200	10
13	130	1300	10
14	140	1400	10
15	150	1500	10
16	160	1600	10
17	170	1700	10
18	180	1800	10
19	190	1900	10
20	200	2000	10
21	210	2100	10
22	220	2200	10
23	230	2300	10
24	240	2400	10
25	250	2500	10
26	260	2600	10
27	270	2700	10
28	280	2800	10
29	290	2900	10
30	300	3000	10
31	310	3100	10
32	320	3200	10
33	330	3300	10
34	340	3400	10
35	350	3500	10
36	360	3600	10
37	370	3700	10
38	380	3800	10
39	390	3900	10
40	400	4000	10
41	410	4100	10
42	420	4200	10
43	430	4300	10
44	440	4400	10
45	450	4500	10
46	460	4600	10
47	470	4700	10
48	480	4800	10
49	490	4900	10
50	500	5000	10
51	510	5100	10
52	520	5200	10
53	530	5300	10
54	540	5400	10
55	550	5500	10
56	560	5600	10
57	570	5700	10
58	580	5800	10
59	590	5900	10
60	600	6000	10
61	610	6100	10
62	620	6200	10
63	630	6300	10
64	640	6400	10
65	650	6500	10
66	660	6600	10
67	670	6700	10
68	680	6800	10
69	690	6900	10
70	700	7000	10
71	710	7100	10
72	720	7200	10
73	730	7300	10
74	740	7400	10
75	750	7500	10
76	760	7600	10
77	770	7700	10
78	780	7800	10
79	790	7900	10
80	800	8000	10
81	810	8100	10
82	820	8200	10
83	830	8300	10
84	840	8400	10
85	850	8500	10
86	860	8600	10
87	870	8700	10
88	880	8800	10
89	890	8900	10
90	900	9000	10
91	910	9100	10
92	920	9200	10
93	930	9300	10
94	940	9400	10
95	950	9500	10
96	960	9600	10
97	970	9700	10
98	980	9800	10
99	990	9900	10
100	1000	10000	10

Sample Printout From
Mineral Occurrence
File: CDCAPROD

MK420 70	29W-	27	2	FAULTS IN QZ MONZONITE	
MK420 90	29W-	25	03	2 00623 STRINGER DISTRICT PLACER	12,13,23,24-30S-40EM
MK420 90	29W-	25	2	STRINGERS IN QZ MONZONITE	
MK405110	29AU	43	03	2 00187 GOLD CROWN	11,12-30S-40EM
MK405110	29AU	43	2	SCHHEELITE, AN BEARING STRINGERS	
MK405110	29AU	77	03	2 00245 LA CROSSE	11-30S-40EM
MK405110	29AU	77	2	SEVERAL 100 OZ, QZ VEIN IN SCHIST	
MK405110	29AU	125	03	1 00324 RIZZ NO 2	12-30S-40EM
MK405110	29AU	125	2	STRINGER IN SCHIST	
MK405110	29AU	149	03	4 SUNSHINE	11-30S-40EM
MK405110	29AU	149	2	\$1060040, SCHIST	
MK405115	29AU	126	03	1 00327 ROSE M	2-30S-40EM
MK405115	29AU	126	2	SHEAR ZONE IN SCHIST	
MK405120	29AU	99	03	2 00281 NANCY HANKS	2-30S-40EM
MK405120	29AU	99	2	FAULT ZONES IN SCHIST	
MK415115	29W-	1	03	2 00550 BARBARA-DIANA	2-30S-40EM
MK415115	29W-	1	2	STRINGERS IN SCHIST	
MK415115	29W-	3	03	2 00556 BLUEBIRD	12-30S-40EM
MK415115	29W-	3	2	QZ VEINS IN SCHIST	
MK415115	29W-	11	03	2 00580 HESS	1-30S-40EM
MK415115	29W-	11	2	STRINGERS IN SCHIST	
MK365260	29AU	3	03	1 00110 APPLE GREEN	30-28S-40EM
MK365260	29AU	3	2	QZ SHEAR ZONES IN QZ MONZONITE	
MK425115	29AU	41	03	2 00185 GOLD COIN	1,12-30S-40EM
MK425115	29AU	41	2	SEVERAL 1000 OZ, VEINS IN SCHIST	
MK425115	29AU	60	03	1 00212 HAWKEYE	1-30S-40EM
MK425115	29AU	60	2	VEIN IN SCHIST	
MK425115	29AU	96	03	2 00275 MONARCH RAND	1-30S-40EM
MK425115	29AU	96	2	FEW 100 OZ, SCHIST ALONG QZ	
MK425115	29AU	5	03	3 00113 BALTIC	1-30S-40EM
MK425115	29AU	5	2	AT LEAST #50K, QZ VEINS IN SCHIST	
MK425115	29AG	3	03	1 JASPER	12-30S-40EM
MK425115	29AG	3	2	SILICIFIED FAULT ZONE IN SCHIST	
MK425115	29AG	6	03	1 NONDESCRIPT	12-30S-40EM
MK425115	29AG	6	2	QZ VEIN IN SCHIST	
MK425115	29AG	10	03	1 VIENNA	12-30S-40EM
MK425115	29AG	10	2	VEINS ALONG FAULT IN SCHIST	
MK425115	29AG	11	03	1 WHITE HORSE RAND	1-30S-40EM
MK425115	29AG	11	2	QZ STRINGERS IN SCHIST	
MK425115	29AG	8	03	1 TOGO	12-30S-40EM
MK425115	29W-	15	03	2 00587 JERSEY LILY	12-30S-40EM
MK425125	29AU	87	03	2 00264 MASTER KEY	1-30S-40EM
MK425125	29AU	87	2	QZ VEINS IN RHYOLITE	
MK390 85	29AU	134	03	1 00338 SILVERTON	22-30S-40EM
MK390 85	29AU	134	2	SHEAR ZONE IN SCHIST	
MK425125	29AU	153	03	1 00362 WADE H.NO.2	1-30S-40EM
MK425125	29AU	153	2	SHEAR ZONE IN QZ MONZONITE	
MK425125	29AG	5	03	1 MIZPAH-NEVADA	1-30S-40EM
MK425125	29AG	5	2	QZ STRINGERS IN QZ MONZONITE	
MK425125	29AG	9	03	1 TREASURE HILL	1-30S-40EM
MK425125	29AG	9	2	QZ BEARING FAULT ZONES IN SCHIST	
MK425125	29W-	9	03	1 00575 GOLD WASH	1-30S-40EM
MK425125	29W-	9	2	STRINGERS & VEINS IN SILICEOUS SCHIST	
MK425150	29AU	104	03	4 00294 OPERATOR DIVIDE	25-29S-40EM
MK425150	29AU	104	2	\$600K, QZ STRINGERS IN SCHIST	
MK425150	29AU	109	03	2 FINMORE	25-29S-40EM
MK425150	29AU	109	2	FEW 1000 OZ, QZ IN SCHIST	
MK385125	29AU	12	03	3 00125 BIG GOLD	3-30S-40EM
MK385125	29AU	12	2	#5005, FAULT ZONE IN QZ MONZONITE	
MK385125	29AU	13	03	1 00131 BOEBY	3-30S-40EM
MK385125	29AU	13	2	VIEN IN METAMORPHIC	



Key to data listings:

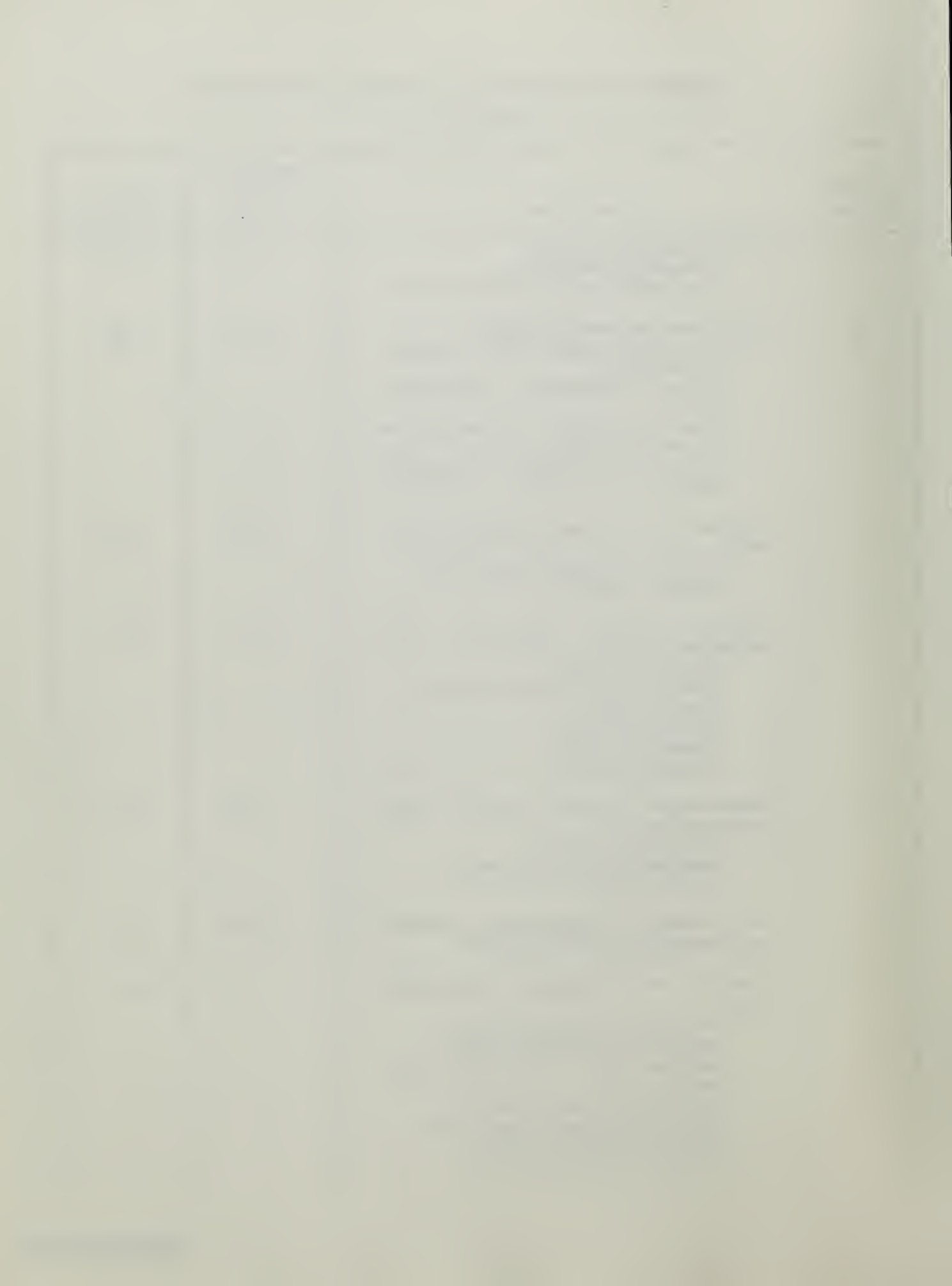


REQUIREMENTS OF
GEOLOGIC INFORMATION

1. UNIFORM
2. COMPLETE
3. DETAIL TO DISTINGUISH NEIGHBORING CELLS
4. RELATED TO MINERALIZATION

GEOLOGIC AND GEOPHYSICAL VARIABLES FOR THE CDCA
Lithologic Units

Variable Number	Description	Areal Extent Within CDCA (km ²)	% Of CDCA Area
1.	Precambrian granitic rocks. - Precambrian anorthosite. - Undivided Precambrian granitic rocks.	701	0.67
2.	Precambrian metamorphic rocks. - Precambrian igneous and metamorphic rock complex. - Earlier Precambrian metamorphic rocks. - Later Precambrian sedimentary and metamorphic rocks. - Undivided Precambrian metamorphic rocks.	5,542	5.28
3.	Cambrian and late Precambrian sedimentary rocks. - Cambrian and Precambrian marine. - Cambrian marine.	1,963	1.87
4.	Ordovician through Mississippian marine sedimentary rocks. - Ordovician marine. - Pre-Silurian metasedimentary rocks. - Silurian marine. - Devonian marine. - Mississippian marine. - Paleozoic marine.	2,318	2.21
5.	Pennsylvanian through Permian marine sedimentary rocks. - Pennsylvanian marine. - Undivided carboniferous marine. - Permian marine.	489	0.47
6.	Pre-Cretaceous metasedimentary rocks and pre-Cretaceous metamorphic rocks.	1,298	1.24
7.	Paleozoic and Precambrian metavolcanic rocks. - Pre-Silurian metamorphic rocks. - Pre-Silurian metavolcanic rocks. - Devonian and pre-Devonian metavolcanic rocks. - Devonian metavolcanic rocks. - Carboniferous metavolcanic rocks. - Permian metavolcanic rocks. - Paleozoic metavolcanic rocks.	14	0.01



8.	Triassic-Jurassic marine sediments. - Triassic marine. - Middle and/or Lower Jurassic marine. - Upper Jurassic marine. - Knoxville Formation.	28	0.03
9.	Pre-Cretaceous metavolcanic rocks (if age cannot be established other than pre-Cretaceous). - Pre-Cretaceous metavolcanic rocks. - Jura-Triassic metavolcanic rocks.	472	0.45
10.	Mesozoic basic intrusives. - Mesozoic ultrabasic intrusive rocks. - Mesozoic basic intrusive rocks.	277	0.26
11.	Mesozoic granitic intrusives and pre-Cenozoic granitic and metamorphic rocks.	14,431	13.76
12.	Eolian deposits.	3,271	3.12
13.	Tertiary sediments (marine and non-marine).	2,860	2.73
14.	Tertiary igneous intrusives (hypabyssal).	515	0.49
15.	Tertiary volcanics. - Eocene volcanics. - Oligocene volcanics. - Miocene volcanics. - Pliocene volcanics.	5,142	4.90
16.	Quaternary sediments. - Plio-Pleistocene non-marine. - Pleistocene non-marine. - Pleistocene marine and marine terrace deposits. - Quaternary non-marine terrace deposits. - Glacial deposits. - Salt deposits. - Basin deposits. - Fan deposits. - Stream channel deposits. - Alluvium.	61,815	58.93
17.	Quaternary volcanics. - Pleistocene volcanics. - Recent volcanics.	1,652	1.57
18.	Bodies of water and unmapped areas.	2,112	2.01
TOTAL		104,900	100.0

GEOLOGICAL AND GEOPHYSICAL VARIABLES FOR THE CDCA
Rock Contact Relationships

Variable Number	Description	Total Length In CDCA (Km)
19	Length of contact between Precambrian granitic rocks (1) and Precambrian metamorphic rocks (2).	481.0
20	Length of contact between Mesozoic granitic intrusives and pre-Cenozoic granitic and metamorphic rocks (11), and either Ordovician through Mississippian marine sedimentary rocks (4), or Pennsylvanian through Permian marine sedimentary rocks (5).	565.0
21	Length of contact between Mesozoic granitic intrusions and pre-Cenozoic granitic and metamorphic rocks (11) and Triassic-Jurassic marine sediments (8).	1.6
22	Length of contact between Tertiary igneous intrusives (14) and Precambrian granitic rocks (1).	0.8
23	Length of contact between Tertiary igneous intrusives (14) and Precambrian metamorphic rocks (2).	53.2
24	Length of contact between Tertiary igneous intrusives (14) and Cambrian and late Precambrian sedimentary rocks (3).	3.2
25	Length of contact between Tertiary igneous intrusives (14) and Ordovician through Mississippian marine sedimentary rocks (4).	5.2
26	Length of contact between Tertiary igneous intrusives (14) and Pennsylvanian through Permian marine sedimentary rocks (5).	9.6
27	Length of contact between Tertiary igneous intrusives (14) and pre-Cretaceous metasedimentary rocks and pre-Cretaceous metamorphic rocks (6).	7.2
28	Length of contact between Tertiary igneous intrusives (14) and Paleozoic and Precambrian metavolcanic rocks (7).	2.8
29	Length of contact between Tertiary igneous intrusives (14) and Triassic-Jurassic marine sediments (8).	2.8
30	Length of contact between Tertiary igneous intrusives (14) and pre-Cretaceous metavolcanic rocks (9).	2.8
31	Length of contact between Tertiary igneous intrusives (14) and Mesozoic basic intrusives (10).	4.8
32	Length of contact between Tertiary igneous intrusives (14) and Mesozoic granitic intrusives and pre-Cenozoic granitic and metamorphic rocks (11).	208.0
33	Length of contact between Tertiary igneous intrusives (14) and eolian deposits (12).	0.1
34	Length of contact between Tertiary igneous intrusives (14) and Tertiary sediments (13).	83.0

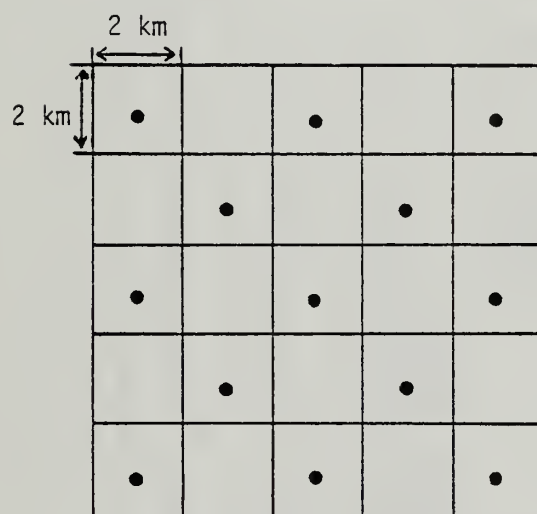
GEOLOGICAL AND GEOPHYSICAL VARIABLES
AND NUMBER OF SUBCELLS
FOR THE CDCA
Structural Relationships

Variable Number	Description	Total In CDCA
35.	Length of thrust faults (km).	518
36.	Number of thrust faults.	415
37.	Length of non-thrust faults (km).	14,907
38.	Number of non-thrust faults.	12,629
39.	Number of fault intersections.	1,889
40.	Curvature of faults.	n/a
41.	Gravity value measured at cell center.	n/a
42.	Number of subcells.	26,812

THE UNIVERSITY OF CHICAGO
LIBRARY



Configuration of Gravity Data



Sample Printout From
4 Km X 4 Km Geologic
Data File: GEOGRAV

MK3624	42	4	4	1	11	19	16	4	19	3	37	4	38	1	40	1	41886
MK3628	42	4	11	20	13	3	16	1	17	1	37	8	38	3	40	1	41890
MK3632	42	4	11	20	16	4	37	10	38	3	40	1	41894				
MK3636	42	4	11	2	16	22	37	7	38	2	40	1	41897				
MK3640	42	4	16	25	37	5	38	2	40	1	41889						
MK3644	42	4	16	25	41884												
MK3648	42	4	16	25	37	18	38	5	40	1	41879						
MK3652	42	4	16	25	37	13	38	6	39	1	40	1	41876				
MK3656	42	4	16	25	37	6	38	2	40	1	41872						
MK3660	42	4	16	25	37	9	38	4	40	1	41865						
MK3664	42	4	16	25	37	31	38	10	40	1	41861						
MK3668	42	4	16	25	37	27	38	15	40	1	41859						
MK3672	42	4	16	23	17	1	37	8	38	5	40	1	41854				
MK3676	42	4	16	18	17	6	37	28	38	12	39	1	40	1	41845		
MK3680	42	4	16	2	17	23	37	40	38	16	39	1	40	3	41847		
MK3684	42	4	17	25	41844												
MK3688	42	4	17	25	41842												
MK3692	42	4	11	2	17	23	41840										
MK3696	42	4	11	15	17	10	41841										
MK4000	42	4	11	20	16	4	41869										
MK4004	42	4	11	6	16	18	37	5	38	2	40	1	41894				
MK4008	42	4	2	7	11	4	16	13	37	10	38	5	40	1	41895		
MK4012	42	4	2	12	11	4	14	1	15	1	16	5	32	1	37	10	38
MK4016	42	4	2	7	16	18	41894										
MK4020	42	4	11	1	13	2	15	3	16	18	37	16	38	4	40	1	41885
MK4024	42	4	11	12	16	13	37	4	38	1	40	1	41883				
MK4028	42	4	11	15	16	9	37	8	38	3	40	1	41892				
MK4032	42	4	11	21	16	3	37	4	38	1	40	1	41896				
MK4036	42	4	11	4	16	21	37	2	38	1	40	1	41896				
MK4040	42	4	16	25	37	6	38	4	40	1	41896						
MK4044	42	4	16	25	37	13	38	4	40	1	41895						
MK4048	42	4	16	25	37	3	38	3	40	1	41893						
MK4052	42	4	16	25	37	6	38	3	40	1	41887						
MK4056	42	4	16	25	41879												
MK4060	42	4	16	25	37	8	38	4	40	1	41869						
MK4064	42	4	16	25	37	7	38	3	40	1	41863						
MK4068	42	4	16	25	37	7	38	3	40	1	41863						
MK4072	42	4	16	24	17	1	37	21	38	9	40	1	41858				
MK4076	42	4	16	8	17	17	37	24	38	11	40	1	41858				
MK4080	42	4	17	25	37	33	36	10	40	1	41858						
MK4084	42	4	11	2	16	2	17	19	41849								
MK4088	42	4	11	8	16	7	17	9	41848								
MK4092	42	4	11	19	16	4	17	1	41853								
MK4096	42	4	11	9	16	16	41849										
MK4400	42	4	11	23	16	1	41863										
MK4404	42	4	11	6	16	18	37	8	38	2	40	1	41896				
MK4408	42	4	11	2	13	3	15	5	16	14	37	6	38	2	40	1	41895
MK4412	42	4	2	1	13	3	14	2	15	6	16	11	34	4	41891		
MK4416	42	4	2	3	13	1	14	1	15	3	15	16	41892				
MK4420	42	4	11	1	13	2	14	1	15	7	16	13	32	3	34	1	37
MK4424	41885																
MK4428	42	4	11	13	14	1	15	3	16	7	32	2	37	10	38	2	40
MK4432	42	4	11	5	16	20	37	1	38	1	41889						
MK4436	42	4	11	22	16	2	37	6	38	3	40	1	41895				
MK4440	42	4	11	14	16	10	37	19	38	7	40	1	41897				
MK4444	42	4	11	1	16	23	37	18	38	5	40	1	41897				
MK4448	42	4	11	12	16	13	37	1	38	1	40	1	41900				
MK4452	42	4	11	13	16	11	41900										
MK4456	42	4	11	1	16	23	37	7	38	3	40	1	41900				
MK4460	42	4	16	25	37	10	38	5	39	1	40	1	41889				
MK4464	42	4	11	2	16	22	37	10	38	5	40	1	41879				

Key to data listings:

UTM Coordinate

Variable

MKU468	42	4	11	8	16	16	17	1	37	27	38	8	39	1	47	1	4	876
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Quantifier

V. GEOSTATISTICAL ANALYSIS

A. PRINCIPLES

B. FINAL SELECTION OF GEOLOGIC VARIABLES

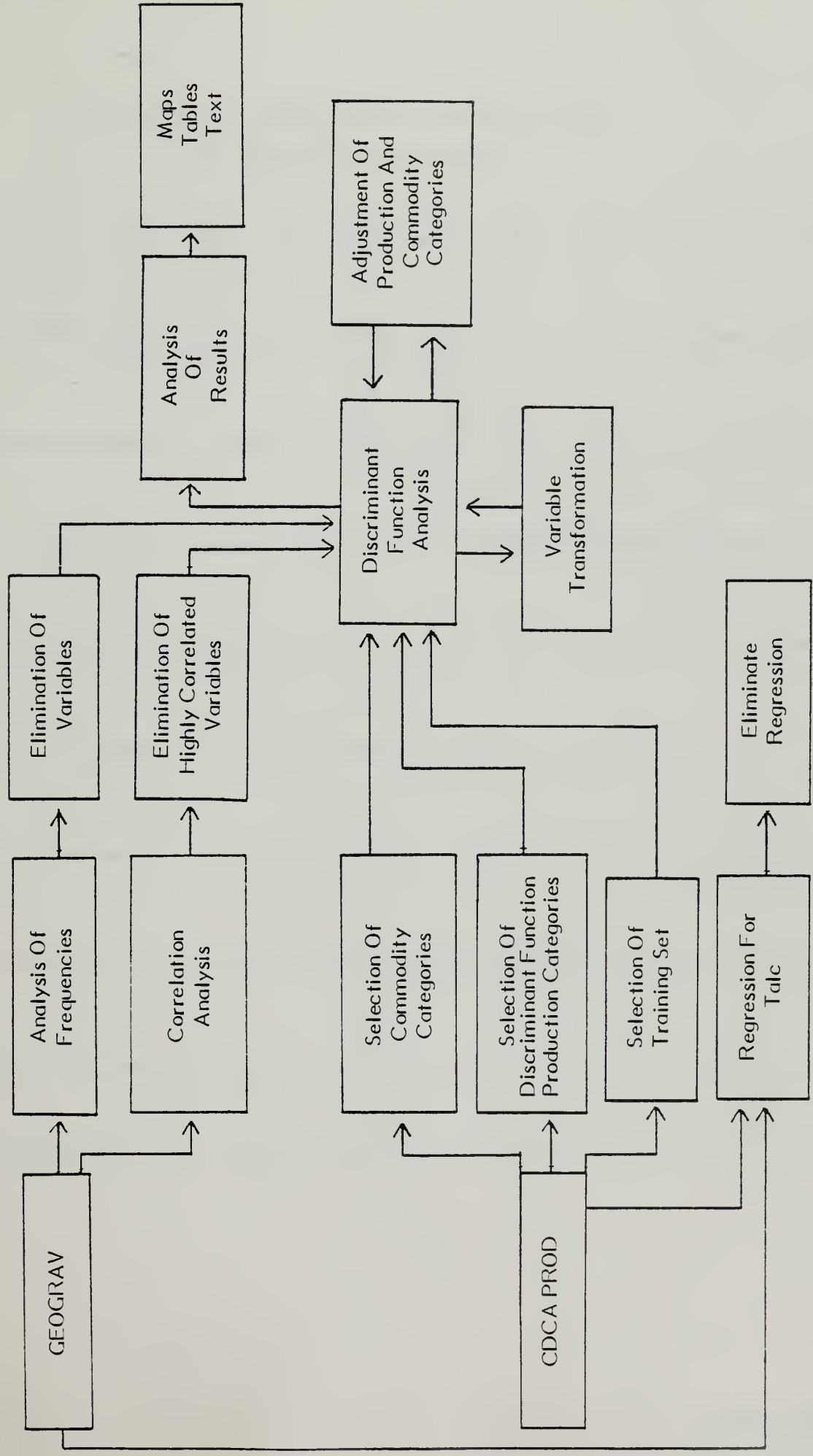
1. ELIMINATE LOW FREQUENCY VARIABLES
2. ELIMINATE VARIABLES WITH NO GEOLOGIC RELEVANCE
3. ELIMINATE HIGHLY CORRELATED VARIABLES

C. SELECTION OF STATISTICAL TECHNIQUE - DISCRIMINANT FUNCTION ANALYSIS

D. DISCRIMINANT FUNCTION ANALYSIS (DFA)

1. OVERVIEW
2. CASES CONSIDERED
 - A. COMMODITY CATEGORIES
 - B. PRODUCTION CATEGORIES
3. TRAINING SETS
4. CASES SELECTED
 - A. ERROR AND SIGNIFICANCE MEASURES
 - B. STATISTICAL INTERPRETATION
 - C. GEOLOGIC INTERPRETATION

FLOW CHART-GEOSTATISTICAL ANALYSIS



PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
All Variables Untransformed

	V2	V3	V4	V5	V6	V9	V10	V11	V12	V13	V14	V15	V16
V1	0.10	-0.02	-0.02	-0.01	0.00	-0.01	-0.01	-0.06	-0.02	-0.01	-0.01	-0.01	-0.11
V2		0.00	-0.04	-0.03	-0.03	-0.02	0.00	-0.08	-0.07	-0.03	-0.02	-0.04	-0.31
V3			0.04	0.00	-0.03	-0.02	-0.02	-0.08	-0.04	-0.04	-0.02	-0.03	-0.18
V4				0.08	-0.02	-0.02	0.02	-0.06	-0.04	-0.02	-0.02	-0.04	-0.21
V5					-0.02	0.04	0.00	-0.02	-0.02	-0.03	-0.01	-0.03	-0.10
V6						-0.01	-0.01	0.01	-0.02	-0.03	-0.01	-0.03	-0.13
V9							0.01	-0.01	-0.02	0.00	-0.01	-0.02	-0.07
V10								0.04	-0.02	-0.02	0.02	-0.02	-0.07
V11									-0.10	-0.08	-0.03	-0.11	-0.49
V12										-0.05	-0.03	-0.08	-0.15
V13											0.02	0.04	-0.18
V14												0.16	-0.10
V15													-0.26
V16													
V17													
V18													
V19													
V20													
V32													
V34													
V35													
V36													
V37													
V38													
V39													
V40													

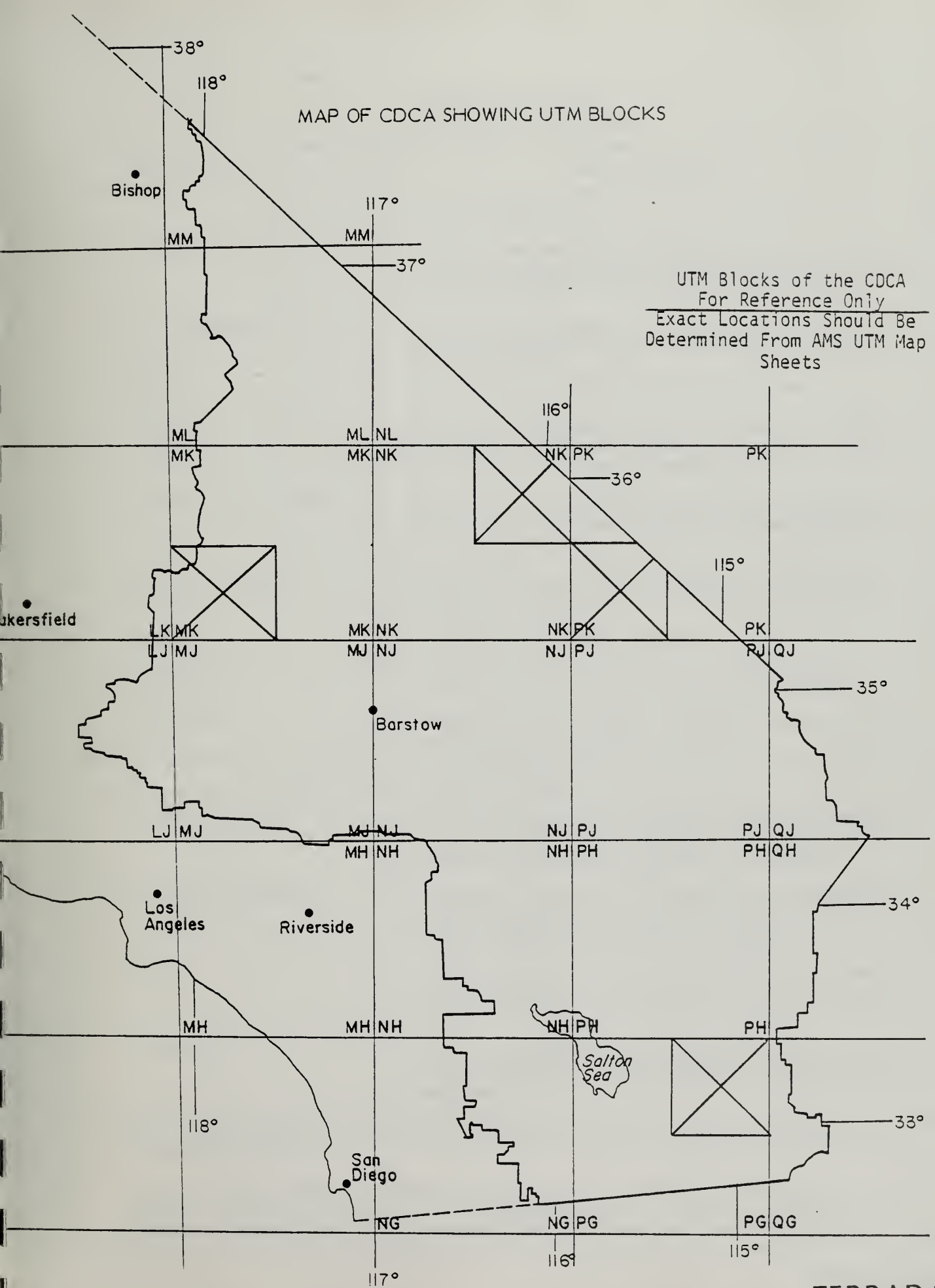
PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
All Variables Untransformed

	V17	V18	V19	V20	V32	V34	V35	V36	V37	V38	V39	V40	V41
V1	-0.02	-0.01	0.45	-0.01	-0.01	-0.01	0.06	0.06	0.02	0.01	0.02	0.06	0.03
V2	-0.05	-0.05	0.25	-0.03	-0.02	-0.01	0.11	0.11	0.18	0.16	0.15	0.13	-0.01
V3	-0.03	-0.01	-0.02	-0.01	-0.01	-0.01	0.12	0.11	0.17	0.18	0.16	0.18	0.02
V4	0.00	0.00	-0.02	0.21	-0.02	-0.01	0.11	0.10	0.07	0.07	0.08	0.09	0.02
V5	0.03	0.01	-0.01	0.23	0.00	-0.01	0.03	0.03	0.07	0.07	0.05	0.05	0.01
V6	-0.03	-0.02	-0.01	-0.01	-0.01	-0.01	0.08	0.08	0.07	0.08	0.06	0.04	-0.04
V9	-0.02	-0.02	-0.01	0.01	0.00	0.00	0.00	0.00	0.04	0.05	0.08	0.02	0.03
V10	-0.02	-0.02	-0.01	0.05	0.00	0.01	-0.01	-0.01	0.04	0.04	0.02	0.00	0.01
V11	-0.02	-0.06	-0.04	0.12	0.09	-0.02	-0.04	-0.04	0.07	0.06	0.00	-0.03	-0.05
V12	-0.04	-0.04	-0.02	-0.02	-0.02	0.00	-0.02	-0.03	-0.09	-0.09	-0.06	-0.04	0.03
V13	-0.02	-0.03	0.00	-0.02	0.00	0.09	0.02	0.03	0.12	0.15	0.10	0.05	-0.04
V14	-0.01	-0.03	-0.01	0.00	0.24	0.25	-0.01	-0.01	0.05	0.05	0.04	-0.01	-0.01
V15	-0.02	-0.04	-0.02	0.00	0.01	0.03	-0.03	-0.03	0.10	0.10	0.08	-0.01	0.03
V16	-0.14	-0.21	-0.11	-0.13	-0.06	-0.03	-0.09	-0.09	-0.27	-0.27	-0.20	-0.13	0.01
V17		-0.03	-0.02	0.00	-0.01	0.00	-0.02	-0.02	-0.04	-0.05	-0.01	-0.01	0.02
V18			-0.02	0.00	0.00	-0.01	-0.02	-0.02	-0.08	-0.07	-0.04	-0.04	0.00
V19				-0.01	-0.01	-0.01	0.03	0.03	0.02	0.01	0.00	0.04	0.03
V20					0.00	-0.01	0.01	0.00	0.03	0.04	0.03	0.02	-0.01
V32						0.02	-0.01	-0.01	0.02	0.02	0.01	-0.01	-0.09
V34							-0.01	-0.01	0.00	0.01	0.00	0.00	-0.04
V35								0.96	0.12	0.13	0.35	0.74	0.03
V36									0.12	0.13	0.37	0.75	0.03
V37										0.95	0.63	0.24	-0.03
V38											0.68	0.26	-0.02
V39												0.36	0.01
V40													0.03

PRELIMINARY COMMODITY CATEGORIES

1. Lead, Silver, Zinc or Copper
2. Gold
3. Iron or Manganese
4. Copper
5. Lead, Silver, Zinc, Copper or Gold
6. Tungsten

MAP OF CDCA SHOWING UTM BLOCKS



UTM Blocks of the CDCA
For Reference Only
Exact Locations Should Be
Determined From AMS UTM Map
Sheets

CASES CONSIDERED
DISCRIMINANT ANALYSIS^(a)

Name of Run	Brief Description
Two-Category Runs	
GOLD NO TRANSF.	High and low probability of occurrence of gold. Unlike other runs, this run does not use transformations on the geologic variables to make them more nearly normal.
GOLD MINRESID	High and low probability of occurrence of gold, with discriminant function found by minimizing $(1 + D^2/4)^{-1}$.
GOLD	High and low probability of occurrence of gold.
HYDRO W/GOLD ^(b)	High and low probability of occurrence of any of the following: gold, lead, silver, zinc, copper, either individually or in any combination.
HYDRO W/O GOLD ^(b)	High and low probability of occurrence of any of the following: lead, silver, zinc, copper, either individually or in any combination.
IRON-MANGANESE	High and low probability of occurrence of either iron or manganese, or both.
COPPER	High and low probability of occurrence of copper.
TUNGSTEN	High and low probability of occurrence of tungsten.
HYDWOGP	Production or no known production of any of the following: lead, silver, zinc, copper.
Three-Category Runs	
HYDRO W/GOLD ^(b)	Occurrence valued at under \$50,000, occurrence valued at over \$50,000, or low probability of occurrence of any of the following: gold, lead, silver, zinc, copper.
HYDRO W/O GOLD ^(b)	Occurrence valued at under \$50,000, occurrence valued at over \$50,000, or low probability of occurrence of any of the following: lead, silver, zinc, copper.
GOLD	Occurrences valued at under \$50,000, occurrence valued at over \$50,000, or low probability of occurrence of gold.
TUNGSTEN	Occurrence valued at under \$50,000, occurrence valued at over \$50,000, or low probability of occurrence of tungsten.

(a) Unless otherwise indicated, the discriminant function is found by maximizing the Mahalanobis distance.

(b) The name "HYDRO" has been used informally here to designate those classes of ore deposits commonly referred to as "hydrothermal", and in this case, specifically, to deposits of copper, lead, zinc and silver occurring individually or in any combination.

TEST OF SIGNIFICANCE OF SEPARATION BETWEEN THE MEANS
IN TWO-CATEGORY DISCRIMINATION^{(a),(b)}

Name of Run	n_1	n_2	k	D^2	F^0	$F_{.05}$	$F_{.01}$
GOLD MINRESID ^(c)	40	572	10	1.39	5.12	1.85	2.36
GOLD NO TRANSF ^(d)	40	572	10	1.41	5.19	1.85	2.36
GOLD	40	572	10	1.39	5.12	1.85	2.36
Gold, Lead, Silver, Zinc, Copper (HYDRO W/GOLD)	86	526	13	1.26	7.02	1.74	2.17
Lead, Silver, Zinc, Copper (HYDRO W/O GOLD)	56	556	16	1.58	4.90	1.37	1.54
HYDWOGP	25	587	13	2.21	4.00	1.74	2.17
IRON-MANGANESE	13	599	8	2.15	3.37	1.69	2.07
COPPER	25	587	10	1.95	4.61	1.85	2.36
TUNGSTEN	21	591	8	2.07	5.19	1.69	2.07

(a) The F-test has been used as discussed on the previous page. When F^0 exceeds $F_{.05}$, the separation between the means is significant at the 95 percent confidence level. When F^0 exceeds $F_{.01}$, the separation is significant at the 99 percent level. As shown in the table, the separation between the means is significant at the 99 percent confidence level in all cases.

(b) Except for case GOLD MINRESID discriminators where chosen by maximizing D^2 .

(c) Here, discriminators were chosen by minimizing $(1 + D^2/4)^{-1}$.

(d) In this case, the discriminators were not transformed to approach normality.



RESULTS OF F-TEST FOR THREE-CATEGORY DISCRIMINATION^{(a),(b)}

Name of Run	Categories Compared	n_1	n_2	n_3	k	D^2	F^0	Confidence Level	
								.05	.01
Lead, Silver, Zinc, Copper (HYDRO W/O GOLD)	1, 2	52	4		18	5.00	0.71	1.83	2.38
	1, 3	52		556	18	1.55	3.98	1.58	1.88
	2, 3		4	556	18	5.24	1.12	1.58	1.88
Gold, Lead, Silver, Zinc, Copper (HYDRO W/GOLD)	1, 2	72	14		16	2.37	1.43	1.79	2.28
	1, 3	72		526	16	1.23	4.75	1.67	2.03
	2, 3		14	526	16	2.57	2.13	1.67	2.03
GOLD	1, 2	29	11		12	2.07	0.98	2.13	2.93
	1, 3	29		572	12	1.45	3.27	1.78	2.22
	2, 3		11	572	12	2.14	1.89	1.78	2.22
TUNGSTEN	1, 2	19	2		6	4.35	0.97	2.85	4.46
	1, 3	19		591	6	2.11	6.42	2.12	2.83
	2, 3		2	591	6	4.30	1.42	2.12	2.83

- (a) The F-test guarantees a certain confidence level when F^0 exceeds the value of F associated with that level.
- (b) Discriminators were chosen by maximizing D^2 .



FIRST PARTIAL APPARENT ERROR RATE P_1 FOR TWO-CATEGORY RUNS^{(a),(b)}

Name of Run	Number n_1 of Cells In Category 1	P_1
GOLD	40	.375
GOLD - MINRESID	40	.375
GOLD NO TRANSF	40	.375
HYDRO W/GOLD	86	.326
HYDRO W/O GOLD	56	.304
IRON - MANGANESE	13	.385
COPPER	25	.480
TUNGSTEN	21	.429

- (a) P_1 is the fraction of training cells in category 1 predicted by the discriminant analysis to be in category 2.
- (b) HYDWOGP is not included in this table.

DFA RESULTS FOR GOLD
Training Cells Correctly and Incorrectly Classified

	Actual	Correctly Classified By DFA	Incorrectly Classified By DFA
Occurrence	40	25 (62.5%)	15 (37.5%)
No Known Occurrence	572	471 (82.3%)	101 (17.7%)
Total	612	496 (81.0%)	116 (19.0%)

DFA RESULTS FOR GOLD^a
DFA VARIABLES

Number	Variable Name	F Value ^b
2	Precambrian metamorphics	22.7
19	Contact of Precambrian granite with Precambrian metamorphics	18.1
11	Mesozoic granite and Pre-Cenozoic granite and metamorphics	16.3
13	Tertiary sediments	4.5
37	Length of non-thrust faults	3.3
41	Bouguer gravity	3.2
39	Number of fault intersections	2.8
10	Mesozoic basic intrusives	2.7
20	Contact of Mesozoic granite with Paleozoic sedimentary rocks	2.4
14	Tertiary intrusives	2.1

^a Geological variables are ranked in decreasing order of their contribution to the discrimination process.

^b F Value is a measure of the relative contribution of the variable to the discriminant function (77).

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DFA RESULTS FOR GOLD
Known Deposits In Low Probability Cells*

Production Category Of Known Deposit	Number In CDCA	Number In Low Probability Cell (Percentage Of Total)
0	166	3 (1.8%)
1	400	15 (3.7%)
2	172	13 (7.6%)
3	46	7 (15.2%)
4	22	5 (22.7%)
TOTAL	806	43 (5.3%)

* Cells classified as 10 percent or less of probability occurrence.

Production Categories:

0 = Occurrence

1 = Workings, but no production

2 = Production under \$50,000

3 = Production between \$50,000 and \$500,000

4 = Production over \$500,000

GEOLOGIC SETTING OF SELECTED GOLD DEPOSITS
IN INYO AND SAN BERNARDINO COUNTIES (1, 2)*

<u>NAME OF MINE OR PROSPECT</u>	<u>GEOLOGIC SETTING</u>	<u>POSSIBLE STATISTICAL VARIABLE</u>
Inyo County		
Arando Mine	Quartz-bearing shear zone in granitic rocks	11
Ashford Mine	Veins in granite gneiss	2 & 11
Burro and Mary F. Claims	Quartz veins in schist	2
Corona Mine	Quartz veins, contact of schist with granite	2 & 19
Del Norte Group	Fractured quartzite	2
Independent Mine	Quartz masses in Precambrian dolorite adjacent to diorite intrusive	2, 19, 11
Skidoo Mine	Brecciated diorite sill intrusive into limestone and quartzite	2, 19, 11
Sunset Mine	Quartz vein in quartz monzonite associated with granitic dike	11
San Bernardino County		
Alvord Mine	Quartz vein in crystalline limestone in contact with granite	2, 19, 11
Brannigan Mine	Quartz veins in Precambrian quartzite	2
Oro Fino Mine	Siliceous shoots in Precambrian quartzite schist and dolomite	2
Williams Well Placers	"Placer" mining of weathered granite mantle	13

* Only representative examples of each setting are listed, in as much as many deposits occur in similar geologic settings.

DFA RESULTS FOR COMBINED LEAD, SILVER, ZINC AND COPPER
Training Cells Correctly and Incorrectly Classified

	Actual	Correctly Classified By DFA	Incorrectly Classified By DFA
Production of \$50,000 or more	4	3 (75.0%)	1 (25.0%)
Occurrence, but production less than \$50,000	52	32 (61.5%)	20 (38.5%)
No Reported Occurrence	556	477 (85.8%)	79 (14.2%)
Total	612	512 (83.7%)	100 (16.3%)

DFA RESULTS FOR COMBINED COPPER-LEAD-ZINC-SILVER^a
DFA VARIABLES

Number	Variable Name	F Value ^b
4	Ordovician through Mississippian marine sediments	31.2
32	Contact Tertiary intrusives (14) with Mesozoic granite (11)	14.7
2	Precambrian metamorphics	14.1
1	Precambrian granite	13.3
14	Tertiary intrusives	9.4
20	Contact Mesozoic granite (11) with Paleozoic sediments (4 and 5)	6.6
5	Pennsylvanian and Permian marine sediments	5.6
3	Cambrian and Precambrian sediments	4.7
11	Mesozoic granite and pre-Cenozoic granite and metamorphics	4.2
41	Bouguer gravity	3.6
19	Contact Precambrian granite (1) with Precambrian metamorphics (2)	3.3
40	Curvature of faults	2.9
39	Number of fault intersections	2.7
36	Number of thrust faults	1.9

^a Geological variables are ranked in decreasing order of their contribution to the discrimination process.

^b F Value is a measure of the relative contribution of the variable to the discriminant function (77).



DFA RESULTS FOR COMBINED LEAD, SILVER, ZINC, AND COPPER
Known Deposits In Low Probability Cells*

Production Category Of Known Deposit	Number In CDCA	Number In Low Probability Cell (Percentage Of Total)
0	160	11 (6.9%)
1	280	18 (6.4%)
2	148	8 (5.4%)
3	30	1 (3.3%)
4	9	0 (0.0%)
TOTAL	627	38 (6.1%)

* Cells classified as 10 percent or less probability of occurrence.

Production Categories:

0 = Occurrence

1 = Workings, but no production

2 = Production under \$50,000

3 = Production between \$50,000 and \$500,000

4 = Production over \$500,000

GEOLOGIC SETTING OF SELECTED COPPER, LEAD, SILVER AND ZINC
MINES AND PROSPECTS IN INYO AND SAN BERNARDINO COUNTIES

<u>MINE OR PROSPECT</u>	<u>COMMODITIES PRESENT OR PRODUCED</u>	<u>GEOLOGIC SETTING</u>	<u>POSSIBLE STATISTICAL VARIABLE</u>
Inyo County			
Sally Ann Mine	Copper	Contact quartz monzonite with Paleozoic metamorphics	20
Argenta Mine	Lead - zinc	Contact of limestone with schist and quartzite	4 & 2
Cerro Gordo Mine	Lead, zinc, silver	Devonian quartzite and marble	4
Darwin District	Lead, silver, zinc, copper	Pennsylvanian limestone, shale, quartzite intruded by granodiorite	20 & 5
Empress Mine	Silver, zinc, copper	Quartz vein in granite, near contact with limestone	4 & 20
Lippincott Mine	Lead, zinc, silver	Siliceous veins in dolomite	4
San Bernardino County			
Blue Bell Mine	Lead, silver, copper	Veins in limestone near in- trusive contact with granite	4 & 20
Gold Hill Group	Silver, lead	Quartz veins in brecciated schist and gneiss	2

THE ANNALS OF THE ROYAL SOCIETY OF MEDICINE

ORIGINAL ARTICLES		REVIEWS	
<p>1. The Effect of the ...</p> <p>2. The Effect of the ...</p> <p>3. The Effect of the ...</p> <p>4. The Effect of the ...</p> <p>5. The Effect of the ...</p> <p>6. The Effect of the ...</p> <p>7. The Effect of the ...</p> <p>8. The Effect of the ...</p> <p>9. The Effect of the ...</p> <p>10. The Effect of the ...</p>		<p>1. The Effect of the ...</p> <p>2. The Effect of the ...</p> <p>3. The Effect of the ...</p> <p>4. The Effect of the ...</p> <p>5. The Effect of the ...</p> <p>6. The Effect of the ...</p> <p>7. The Effect of the ...</p> <p>8. The Effect of the ...</p> <p>9. The Effect of the ...</p> <p>10. The Effect of the ...</p>	

DFA RESULTS FOR IRON AND MANGANESE
Training Cells Correctly and Incorrectly Classified

	Actual	Correctly Classified By DFA	Incorrectly Classified By DFA
Occurrence	13	8 (61.5%)	5 (38.5%)
No Known Occurrence	599	548 (91.5%)	51 (8.5%)
Total	612	556 (90.8%)	56 (9.2%)

DFA RESULTS FOR IRON AND MANGANESE^a
DFA VARIABLES

Number	Variable Name	F Value ^b
14	Tertiary igneous intrusives	25.3
2	Precambrian metamorphics	13.1
34	Contact of Tertiary sediments and Tertiary igneous intrusives	8.5
32	Contact between Tertiary igneous intrusives and Mesozoic granitic intrusives	5.6
15	Tertiary volcanics	3.3

^a Geological variables are ranked in decreasing order of their contribution to the discrimination process.

^b F Value is a measure of the relative contribution of the variable to the discriminant function (77).

DFA RESULTS FOR IRON AND MANGANESE
Known Deposits In Low Probability Cells*

Production Category Of Known Deposit	Number In CDCA	Number In Low Probability Cell (Percentage Of Total)
0	55	30 (54.5%)
1	76	33 (43.4%)
2	40	19 (47.5%)
3	4	4 (100.0%)
4	3	1 (33.3%)
TOTAL	178	87 (48.9%)

* Cells classified as 10 percent or less probability of occurrence.

Production Categories:

- 0 = Occurrence
- 1 = Workings, but no production
- 2 = Production under \$50,000
- 3 = Production between \$50,000 and \$500,000
- 4 = Production over \$500,000



VI. RECOMMENDATIONS

- A. INCORPORATE ADDITIONAL DATA
(ESPECIALLY LANDSAT)
- B. REFINE TECHNIQUE
- C. PERFORM LOCAL STUDIES

Bureau of Land Management
Library
Bldg. 50, Denver Federal Center
Denver, CO 80225

U.S. DEPARTMENT OF
BUREAU OF LAND
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